Communication and Coordination Plan for Stem Rust of Wheat caused by *Puccinia graminis* f. sp. *tritici* Ug99

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Photos: T.D. Murray

Stem Rust

Historically one of the most important wheat & barley diseases worldwide

Major epidemics in ND, SD & MN from 1935-50s resulted in 250 million bushel loss ($3.7B)

Effectively controlled in the U.S. since 1956

➔ Great concern for spread of Ug99 to the U.S.

- Limited mainly to east Africa

- Several races with different virulence genes that render 80% of world wheat varieties susceptible

Stem Rust Recovery Plan

Original recovery plan: October 2008 to 2010

Updated plan requested April 2011

➔Include sections on Communication and Coordination & Timeline to Recovery

Working group	
Gary Bergstrom	Cornell University
Erick DeWolf	Kansas State University
Marty Draper	USDA-NIFA
Prakash Hebbar	USDA-APHIS
Scott Isard	Pennsylvania State University
Yue Jin	USDA-ARS
Tim Murray	Washington State University
Pierce Paul	Ohio State University
Michael Pumphrey	Washington State University
Matt Rouse	USDA-ARS
Mark Sorrells	Cornell University
Les Szabo	USDA-ARS

Challenges Detecting Ug99

Stem rust is not an exotic disease in the U.S.

- **Can't determine if it's Ug99 by looking at infected plants in the field**
- **Time lag after detection is critical to limiting spread**

➔ **Need effective communication among parties involved to minimize infestation**

Coordination and Communication

National Cereal Pathology Committees

WERA-97 & NCERA-184

= Western, North Central Education & Research Activities

Meet annually to discuss current/new outbreaks, research activities, and personnel changes

➔ coordinate activities within regions

Coordination and Communication

Erick DeWolf, KSU

NIFA Critical Emerging Issues 2007 "*Preparing for Wheat Stem Rust Races TTKSK (Ug99) and TTKST: Enhancement of the National Surveillance Network and Development of Control Recommendations*" & "*Development of Critical Extension Resources for Emerging Races of Wheat Stem Rust (Ug99)*"

Two meetings of cereal pathologists July '08 & October '10

➔ **Identify knowledge gaps in survey & monitoring, communication & IT, diagnostics, barberry survey, and management strategies**

Extension of Results to Stakeholders

Identifying Rust Diseases of Wheat and Barley

Rust diseases are among the most widespread and economically important diseases of cereal crops worldwide. Three distinct diseases, leaf rust, stripe rust and stem rust, occur on wheat and barley in North America. The fungi that cause these diseases are notorious for their ability to increase rapidly and overcome the resistance of wheat or barley varieties. The potential yield loss caused by these diseases depends on host susceptibility and weather conditions, but the loss also is influenced by the timing and severity of disease outbreaks relative to crop growth stage. The greatest yield losses occur when one or more of these diseases occur before the heading stage of development. Early detection and proper identification are critical to in-season disease management and future variety selection.

Figure 1. *The diagnosis of rust diseases requires some basic understanding of plant anatomy and a quick review of this information may improve the accuracy of the identification process.*

Emerging Races of Stem Rust

Historically, stem rust has been an extremely important disease of wheat and barley. A series of severe outbreaks occurred in North America between 1900 and the 1950s, affecting grain production in the Great Plains, many Midwestern states, and Canada. More localized outbreaks of the disease occurred in the southern Great Plains as recently as 1985-1986. In all of these cases, the increased frequency and intensity of the stem rust epidemics was associated with the emergence of new races of the fungus that were able to overcome the genetic resistance of many popular varieties.

Once again, after several decades of control with disease-resistant varieties, new races of the stem rust fungus are threatening grain production in some parts of the world. The first of these variants, known as "Ug99," was initially reported in the East African countries of Uganda, Kenya, and Ethiopia. Additional variants also have emerged, further complicating efforts to contain the problem. The disease continues to spread and may soon threaten wheat and barley production in North America. The rapid detection of the new races is an important component of the international response to these emerging disease threats.

Identification and Management of Stem Rust on Wheat and Barley

Stem rust, leaf rust, and stripe rust comprise a complex of diseases that reduces wheat and barley grain production. These rust diseases occur in nearly all areas of the United States and Canada. The importance of any member of the complex at a given location is determined by specific interactions with current wheat varieties, crop growth stage, and weather conditions.

Stem rust has been present in North America for hundreds of years. A series of particularly severe outbreaks occurred during the early 1930s and 1950s. These outbreaks caused serious yield loss in many parts of the United States and Canada with the greatest losses in the Great Plains. More localized outbreaks of wheat stem rust occurred in the southern Great Plains as recently as 1986. Stem rust became a problem in barley in the late 1980s and early 1990s. In all these cases, the increase in frequency and intensity of the disease was associated with changes in the population of the stem rust fungus, which enabled it to overcome genetic resistance of common varieties.

After several decades of control with genetic resistance, new genetic variants (races) of the stem rust fungus have emerged as a threat to wheat production. The first of these races, known as 'Ug99', was originally detected in Uganda, Kenya, and Ethiopia. Since this initial detection, additional races of the fungus have been reported and are further complicating efforts to contain the problem.

If these new races spread to North America, they may threaten wheat and barley production. In preparation for the possible introduction of these new races of stem rust, a number of critical questions arise regarding the most effective ways to identify, monitor, and manage the disease. This publication answers these critical questions with the best available information about the emerging threat.

Why does the genetic resistance appear to fail?

Currently genetic resistance is an effective means of managing the rust diseases of wheat and barley. Because the populations of the fungi that cause rust diseases can change and adapt to the resistance genes of current varieties, the durability of this genetic resistance has been problematic. These changes occur when naturally occurring genetic changes allow members of the fungal population to overcome the genetic resistance of the plant. The rust fungi have a tremendous reproduction potential and are easily moved by wind; therefore, a new race of stem rust often increases rapidly, resulting in outbreaks of disease throughout a large geographical region.

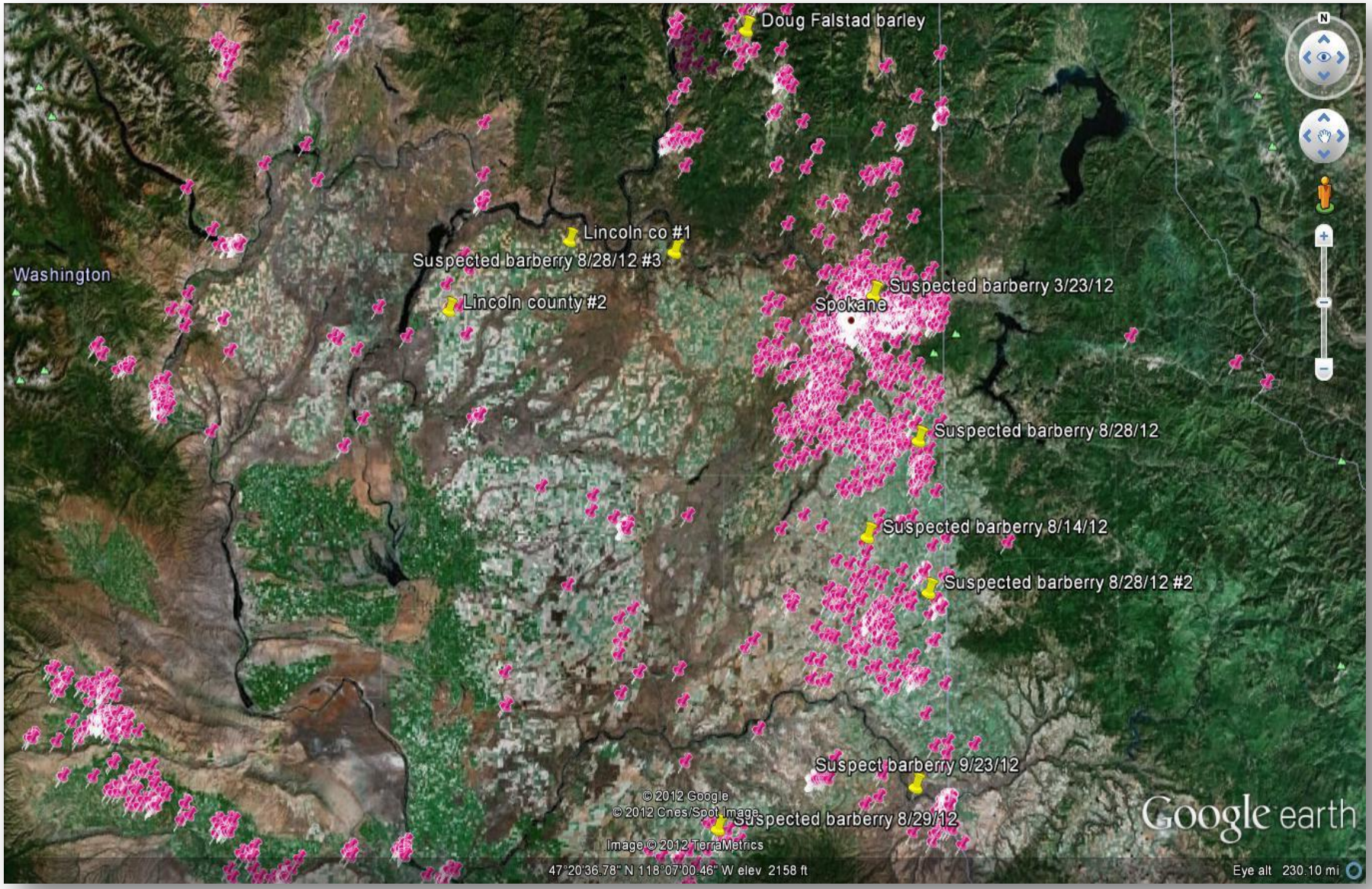
What is the regional risk of stem rust epidemics?

If stem rust reemerges as a serious problem in North America, historical accounts of stem rust outbreaks will provide important information about where the disease is likely to be most severe and cause the largest reductions in yield. Stem rust normally survives the winter months in the southern United States and Mexico. The disease then becomes established near overwintering locations in southern states and is subsequently moved north by weather systems. Potential yield

National extension publications

- customized by state

Historic Barberry & Current Rust Detections



Coordination and Communication

Isard, Szabo & DeWolf

NIFA Biosecurity Grant

- develop cereal rust IT platform for observation network
- development of molecular diagnostic tools

Two meetings of steering committee

➔ **prototype communication plan**

Stem Rust Recovery Plan Update

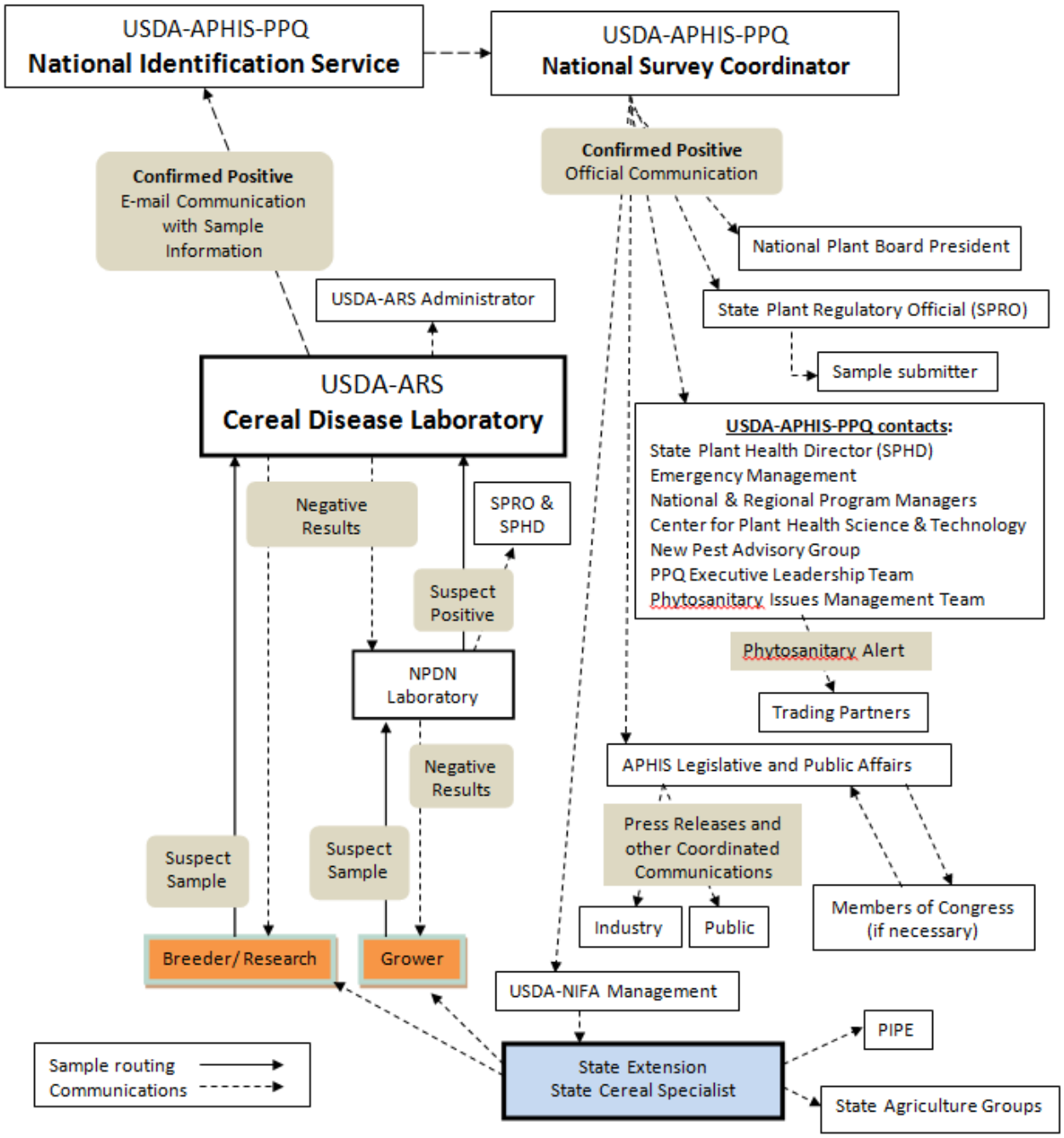
Ug99 Stem Rust Communication meeting, Feb 2012

Multiple agencies & organizations involved with detection and diagnosis

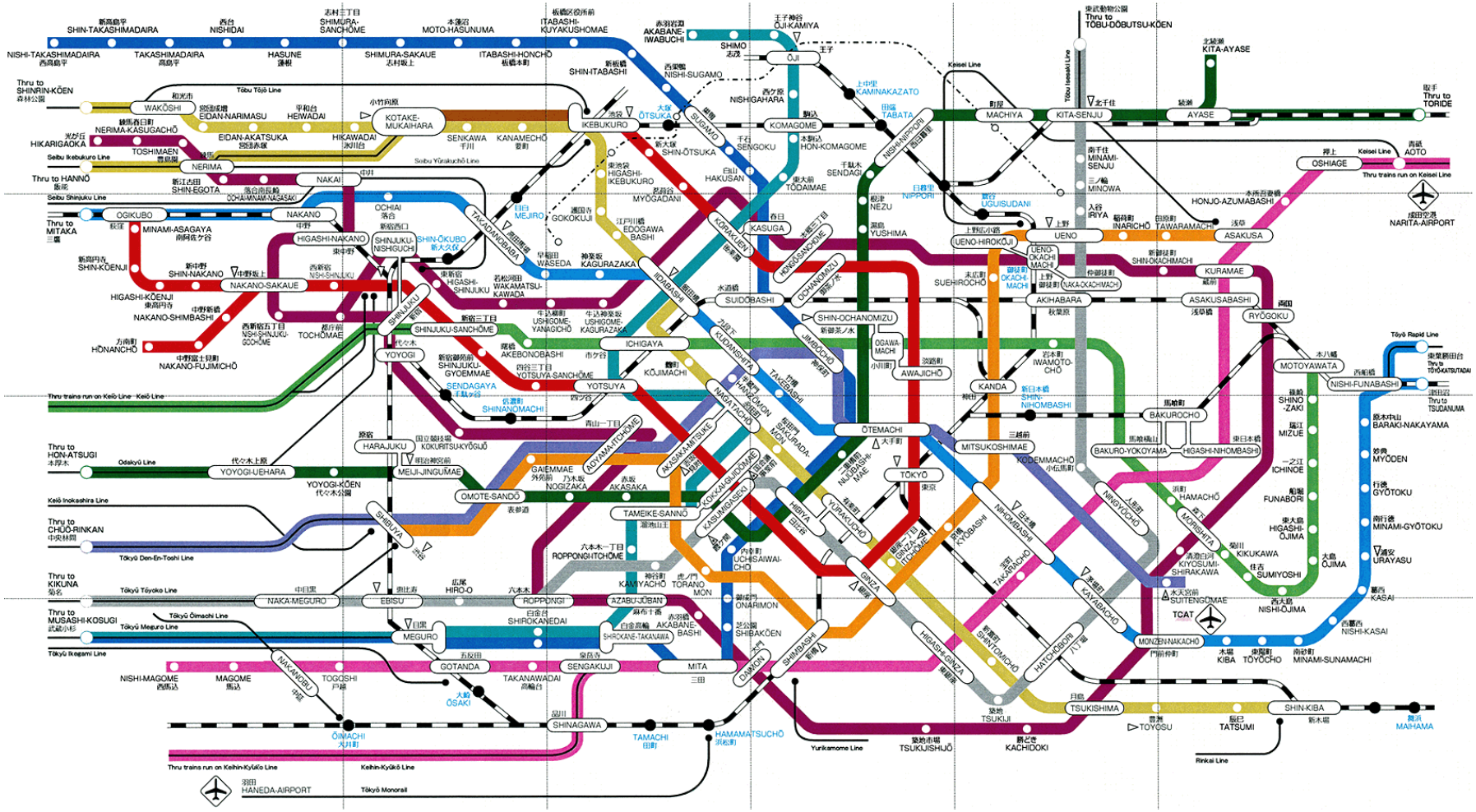
➔Bring everyone together to discuss how information might flow following detection

Communication Plan Meeting	
Gary Bergstrom	Cornell University
Mike Cooper	NPB - Chair
Erick DeWolf	Kansas State University
Marty Draper	USDA-NIFA
Deb Fravel	USDA-ARS
Joel Floyd	USDA-APHIS
Prakash Hebbar	USDA-APHIS
Carrie Harman	University of Florida
David Marshall	USDA-ARS
Tim Murray	Washington State University
Mary Palm	USDA-APHIS
Les Szabo	USDA-ARS
Andrew Wilds	USDA-APHIS

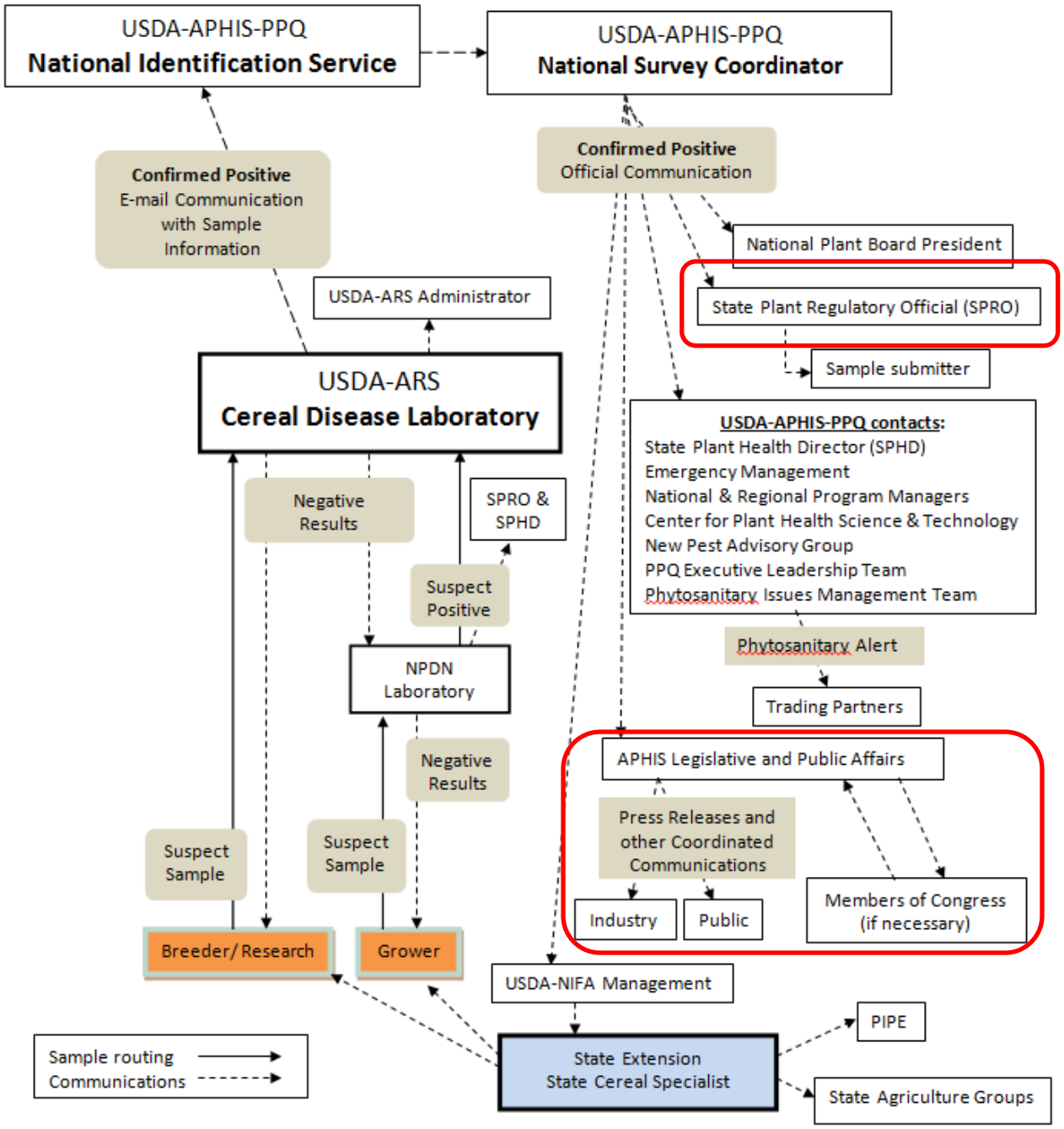
Sample Routing, Confirmation and Communication Plan for New Ug99 Stem Rust Detection



Tokyo Subway Map



Communication Plan for New Ug99 Stem Rust Detection



Take Home Points
Communication and Coordination

Federal agencies primary role in detection

Land grant universities primary role in recovery

- **Scientific community needs to be in the loop**
  - Who will be involved post-detection?
  - Simulation exercises are useful to identify where communication breaks down
- **First detector/producer needs to be kept in the loop**

  ➔ *"Why am I shutdown?"*
- **Need good communication within & between agencies, organizations, and existing networks**